Walking with… / Science Marches On

Top: *Utahraptor* CGI model for the show from 1999.
Bottom: *Utahraptor* restoration from 2014 by Emily Willoughby .
While *Walking With Dinosaurs* was generally accurate for when it was made, it is over two decades old now. New evidence regarding behavior, color and other details are always emerging. So, there are inaccuracies.

Walking With Dinosaurs

In general

- In 2019, the YouTuber Ben G. Thomas made a series dedicated to the accuracies and inaccuracies of each episode in the series according to current science which can be found here .

- Most coelurosaurs certainly had feathers. The several dromaeosaurid species surely had them, but in the franchise they are all shown featherless: this, rather than Science Marches On, might be interpreted more as Rule of Cool, or rather, Artistic License – Paleontology, since feathered raptors would have appeared "too cute"? In Real Life dromeosaurids had WINGS just like their famous relative, the "ur-bird" *Archaeopteryx*... This might be nothing compared to what is seeming to come: *most small-sized dinosaurs* may well have had some sort of covering. This theory was led by the discoveries of the primitive herbivore *Tianyulong* in China and *Kulindadromeus* in Russia, and further supported by the discovery of feathers or feather-like filaments in two anurognathid pterosaur specimens from China: the theory is that some kind of covering was present in the last common ancestor of *all* dinosaurs and pterosaurs, and then it was partially lost by its largest descendants, possibly because of the surface area to volume ratio . Some think the "spikes" on *Diplodocus* have the same common origin of feathers, as well as the quill of the small herbivore *Psittacosaurus* and even the horny bumps lined on the back of several hadrosaur mummies.
- While the pterosaurs are correctly portrayed with pycnofibers, in all cases this is very sparse and in the CG models, basically nonexistent. In reality, it's probable that pterosaur pelts were equal in density to typical land mammals (such as bats), and most species would have been very noticeably fluffy/furry. For instance, compare their *Anurognathus* ◇ to a modern reconstruction .
- They tried to partially remedy all the issues by showing *Walking with Dinosaurs* again in 2008 with updated narration. Unfortunately, the visuals remained untouched, so the small carnivore *Ornitholestes* still had a horn, coelurosaurs were still scaly, so on and so forth.
- Any and all shots of pterosaurs taking off bipedally became inaccurate after it was discovered that they launched quadrupedally. The documentary also avoids showing the large pterosaurs taking off almost entirely, because at the time it was uncertain how such large flying animals could lift up from the ground. It's now known that they probably pushed off their front limbs to vault themselves into the air.
- All the non-avian theropods have pronated hands, a position that is impossible in reality, instead they held their hands out to the sides, akin to their relatives the birds.
- Pterosaurs wings have two major problems- one, they all come to an acute point, while we now know that many of the larger families would have had rounded wings, and when landed the wings folded outward like an origami crane, as opposed to the (rather complicated and hard to model) way they folded inwards and behind the animal's arms.

- The series uses the Noisy Nature approach that was universal to dinosaur restorations at the time (although it's commendable here because the series went to the extra effort to give each animal species their own unique calls), such as giving sauropods whale-like bellows and *Tyrannosaurus* a Mighty Roar, but later studies from 2009 and 2016 have suggested it's likely non-avian dinosaur vocalization would've been limited in comparison to modern birds and mammals due to crocodilians, as the closest relatives of dinosaurs, having a more primitive larynx compared to mammals, and the dinosaurs not having the syrinx that modern birds have for vocalization. Some of the predators, *Postosuchus* in particular, vocalize a lot while pouncing on their prey (though others, like *Allosaurus* and *Utahraptor*, are more realistically silent).

New Blood

- A complete in depth review of the episode done in 2019 by Ben G. Thomas can be found here
- What was thought to be evidence for "cannibalistic *Coelophysis*" has been discredited. Some of the evidence was cannibalism was later seen as adult *Coelophysis* simply having died on top of juveniles, while the stomach contents of other adult *Coelophysis* was determined to be that of small crocodilians, not younger *Coelophysis*. Granted, cannibalism in times of scarcity is pretty common among carnivores and is even confirmed to be the case in other theropods like *Allosaurus* and T. rex, so *Coelophysis* being cannibalistic is very plausible.
- As the now-synonymous *Megapnosaurus* indicates, *Coelophysis* was nocturnal.
- The narration states that dinosaurs first appeared as small predators. Nowadays, it would be much more accurate and probable that the first dinosaurs were omnivorous and later diverged into carnivores and herbivores, but even the notion of omnivorous dinosaurs was controversial back then.
- The early long-necked dinosaur *Plateosaurus* could not walk on four legs.
- The pillar-limbed croc-relative *Postosuchus* was most likely a biped, or at least semi-bipedal, rather than an obligate quadruped. It would be a pursuit predator, not a slow ambush predator. However, it does rear up on its back legs in the episode for brief moments.

- There were no cynodonts of the size depicted in the program in the late Triassic[note] other than traversodonts. Given that some Mesozoic mammals reached similar sizes (such as the infamous *Repenomamus*), cynodonts that big in that time period aren't strictly unlikely, but unknown from the area the episode took place. This is an example of Science Marches On rather than Artistic License – Paleontology because at the time the series was produced it was assumed that cynodonts of that size did live in Late Triassic in North America. This assumption was based on the discovery of two teeth from Chinle Formation [note] though these teeth were assumed to belong to traversodont cynodonts, very different from *Thrinaxodon* that WWD-cynodonts were based on. However, post-WWD study indicates that these teeth can't be confidently referred to Cynodontia (or any other known group of Triassic amniotes, for that matter).
- The cynodonts are depicted with highly altricial offspring, which would have been a reasonable assumption at the time since the more "primitive" living mammals, the marsupials and monotremes, have highly altricial offspring. However, later fossils of primitive mammals, specifically multituberculates, which are between marsupials and monotremes, and the non-mammalian cynodont *Kayentatherium* indicates they had well-formed offspring at birth/hatching (in the case of *Kayentatherium*, it's possible they were independent immediately after hatching and did not have parental care), suggesting the altricial offspring of monotremes and marsupials might be a derived attribute rather than the original state of cynodont offspring. The *Kayentatherium* fossil also suggests that complex parental care did not appear until the evolution of near-mammalian cynodonts.
- The youngest known dicynodont is not *Placerias* anymore, with *Lisowicia* known from roughly eight million years later in Poland. Other fossil evidence from around the world also suggests that, although dicynodonts were never necessarily diverse in any Late Triassic ecosystem, as a group they were widespread and were continuing to evolve up until the very end of the Triassic.
- Another error with the *Placerias* is depicting them with tusks. Unlike most dicynodonts, *Placerias* actually had horn-like protrusions of bone projecting straight from its skull rather than tusks (technically, it also had tusks, but they're very small and hidden underneath these protrusions).
- Another minor error is that *Placerias* is known from two morphotypes of equal ratio, one with longer tusks than the other, and usually believed to be the male and female forms (this was actually noted in scientific descriptions long before the production of WWD, but the literature was rather obscure and would've been difficult to find, making this a borderline example), but the version here is depicted without this dimorphism.

- The most glaring example by far is how *Postosuchus* and *Placerias* are both depicted as sluggish and ungainly relics from a bygone age that are destined to be supplanted by the "superior" dinosaurs (not unlike how we used to view dinosaurs themselves back in the early to mid-20th century in relation to mammals), who are framed as being more versatile, fleet-footed and have the unique gift of bipedalism. Suffice to say, none of that is true, as all terrestrial Triassic tetrapods were just as agile, sophisticated, and well-adapted to their enviroment as early dinosaurs and most of them likely died out as a result of the Triassic-Jurassic mass extinction , which also allowed dinosaurs to take over (in the same way mammals took over thanks to the K-T mass extinction)[note] The narration by Kenneth Branagh does mention the Triassic-Jurassic extinction during the credits, mostly glossing over it by stating how the dinosaurs have continued to evolve, and bipedalism wasn't unique to dinosaurs, as several other contemporary archosaurs, such as rauisuchids (including *Postosuchus*), proposaurids, and shuvosaurids were also bipedal and shared many other morphological similarities to true dinosaurs (the last of which looked nigh-identical to dinosaur ◇ to the untrained eye ◇).

Time of the Titans

- In 2019 Ben G. Thomas created an up to date analysis of the episode which can be found here .
- *Allosaurus* was generally not as huge as depicted here, as most adult specimens are around 8-9 meters in length, not 12 meters. This may have resulted from confusion with a close relative called *Saurophaganax maximus* which actually did grow to 10.5-12 meters and 4-5 tons. However, some scientists do consider the two to be the same animal (although still as a separate species, *Allosaurus maximus*, as opposed to the species most are familiar with, *Allosaurus fragilis*). That said, fossils of giant allosaurs (including the giant *Allosaurus amplexus* as well as *Saurophaganax*) are incredibly rare at Morrison and usually very fragmentary while the mid-sized *Allosaurus fragilis* is much more common, to the point of being the best documented of all macropredatory theropods. This also implies that the giant variety was a rare sight, which would make sense, as the large apex predator in any given ecosystem is bound to be rarer compared to the smaller mesocarnivores. So showcasing the larger species in favor of the smaller one is more Rule of Cool rather than an accurate reflection of reality. *The Ballad of Big Al* does somewhat fix this issue, by emphasizing that gigantic specimens of *Allosaurus* are indeed a rare sight, but presents it as being due to most *Allosaurus* not living long enough to reach their adult size instead of being a case of species diversity and/or size variation within a species, as relatively few specimens in any given species reach their maximum potential size even if they live long lives.

- The idea that *Ornitholestes* had a nasal crest was based on the fact that post-mortem damage to the type fossil had warped the bones of the snout upwards. In Real Life, their noses were almost certainly unadorned (there was a group of Jurassic coelurosaurs known with nasal crests, the proceratosaurids, the earliest known group of tyrannosaurs; interestingly, *Ornitholestes* was once considered related to the type genus, *Proceratosaurus*).
- A study from 2007 suggests that *Anurognathus* and its ilk were nocturnal and caught insects on the fly, like bats or swifts, making the "Mesozoic oxpecker" idea presented on the show highly unlikely (and that's not even mentioning that *Anurognathus* isn't even known from the same continent as *Diplodocus*).
- The episode also depicts the European *Anurognathus* in North America and interacting with otherwise North American animals. This is probably because the actual pterosaur fossils of the Morrison Formation are pretty terrible. However, the genus *Mesadactylus* was tentatively classified as an anurognathid in 2007, so they could have used that instead of *Anurognathus* nowadays.
- The WWD portrayal also places *Anurognathus*' eyes in the wrong skull hole, the upper temporal fenestra rather than the orbit, making its face seem longer than it really was. Notice the shrinkwrapped circle in front of the eye in this prop ◇? That's where the eye *should* be. This is what makes it likely that *Anurognathus* was actually a nocturnal predator; its eyes were enormous ◇ (each eye *alone* was bigger than its brain). Where WWD placed its eyes were actually where jaw muscles would have been attached.
- The *Diplodocus* is depicted as nesting individually, but only a few years later there were extensive bonebeds discovered that indicated sauropods (or titanosaurs at least) nested in large colonies like hadrosaurs or modern day seabirds.
- Post-WWD studies indicate that sauropod dinosaurs probably didn't grow to adult size within more or less ten years as shown in the series, although exactly how fast they grew is still debated (current estimates range from less than four decades to up to 70 years of growth necessary to reach maximum adult size).
- It's stated the *Diplodocus* is the longest of all the sauropods, however subsequent fossils of a contemporary diplodocid, *Supersaurus*, may exceed the largest *Diplodocus* in size, with partial remains suggesting monstrous sizes of up to one-hundred-and-fifty feet in length (if BYU 9024 is in fact assignable to *Supersaurus*).
- The idea that most sauropods (brachiosaurids such as *Brachiosaurus* being the exception) could only hold their necks horizontally - which influenced the WWD reconstructions of *Diplodocus*, *Apatosaurus* and *Argentinosaurus*, which in turn probably popularized the concept - is questioned nowadays as well , although the show's portrayal still has adherents .
- "Iguana-spike-backed" *Diplodocus*: Some researchers now argue these spikes were spread across on *Diplodocus*' back rather than put in a single line as shown in the program.

- Footprints from a baby bipedal sauropod were found in 2010: Perhaps Littlefoot and the WWD sauropodlets *walked on two legs* and become quadrupedal only when they grew larger (an ancient heritage from their ancestors, the "prosauropods" such as the aforementioned *Plateosaurus*)! However, most paleontologists are skeptical of this interpretation. Even the trackways of adult sauropods often leave just the prints from just one pair of feet, thus is even more likely about the younger ones.
- *Brachiosaurus* is no longer considered the largest land animal; the exact species of sauropod that was is not clear, one such candidate being *Argentinosaurus*, but it wasn't *Brachiosaurus*. The weight measurement given in the episode is also a bit higher than the maximum weight estimates considered plausible nowadays (over 70 tonnes versus less than 60 tonnes). This is likely due to weight calculation methods done on *Giraffatitan* (then considered a species a *Brachiosaurus*) which are now considered to be flawed.
- The sauropods are depicted with nostrils on their foreheads (this was because the nasal openings on the skull were located there, so it was assumed the nostrils were there as well), but nowadays a position near the tip of the snout as with most dinosaurs is considered far more likely (it was later pointed out that in all land vertebrates the nostrils were located *in front* of the bony nasal openings and not *on* them).
- Evidence suggests that *Stegosaurus* lived in herds and would have preferred the open savanna regions of the Morrison formation to the more forested areas. Also, a 2011 skin impression of *Hesperosaurus* has shown stegosaur plates were covered in horn rather than skin.[note] The idea that the plates had a horny sheath have been suggested for years, but this discovery officially confirms it. So much for the scene where the *Stegosaurus* changes the color of its plates by flushing blood into them. And then in 2014 came "Sophie", the most-complete specimen of *Stegosaurus* to date, which revealed that *Stegosaurus*'s neck and tail were longer than previously thought, the hindlegs were slightly shorter, and the tip of its tail pointed downwards. Although given Sophie is a juvenile, it's likely adult *Stegosaurus* would have been similar in proportion to the show's design, but still with a longer neck and the tail pointing downward.

    Another detail that should be changed is the orientation of the tail spikes. Traditionally, they are depicted erupting mostly vertically, but fossils with the tail spikes still in place show that it should be more horizontal. In hindsight, this is more logical since the position makes it much easier to use the spikes as side-to-side swiping weapons.

- Another that was speculative to begin with: The idea that dung beetles coevolved with sauropods like *Diplodocus*, which was inspired by fossil evidence of dung beetle activity in dung of *ornithopod* dinosaurs from the end of the Cretaceous (*Maiasaura*), rather than Jurassic sauropods. Phylogenetic studies in the 2010s indicate that dung beetles first diversified in the Early Cretaceous in conjunction with flower plants and ornithopod dinosaurs - thus supporting the paleontological consensus of The '90s, but going against the assumption of the show. Something must have eaten sauropod dung back then, but it wasn't our dung beetles.
- The idea that sauropods relied on gastroliths to digest plant matter is considered unlikely according to a 2014 study , since it would require hundreds of pounds of rocks to adequately grind up plant matter inside them, but gastrolith fossils are comparatively rare, strongly suggesting that sauropods did *not* have hundreds of pounds of rocks inside them all the time. More likely, sauropods just relied on their massive gut to slowly digest vegetation and simply happened to swallow rocks by accident on occasion while grazing.
- The shape of *Diplodocus*'s head changed more dramatically as it grew, from a narrower and more triangular shape in subadults to the flatter muzzles of the adults.
- Later discoveries of well-preserved sauropod skulls show that they had gums covering their teeth and a keratin covering on the end of the mouth forming into a beak-like structure. This is in stark contrast to the series depiction of sauropods with fleshy lips or exposed teeth.
- A well-preserved fossil of *Stegosaurus* found in 2019 shows that the animal was much more slender and long, as opposed to the more compact, hunchbacked reconstruction of the show.
- In 2007, the best material of *Othnielia* was placed in the newly-coined genus *Othnielosaurus* based on studies on the teeth of Morrison ornithischians. And then in 2018, *Othnielosaurus* and *Othnielia* along with *Drinker* have been discovered to be the same animal as *Nanosaurus*.
- A 2022 study on dinosaur skin impressions reported that *Allosaurus* (and some other species of theropod) had broad, flattened scales on its underside like those on the bellies of crocodilians or snakes, and had scutes under its neck. Both features are obviously absent in the version seen here.

Cruel Sea

- An analysis done in 2020 by Ben G. Thomas analyzing the accuracy of the episode can be found here .

- The small size of the holotype of the megalosaur *Eustreptospondylus oxoniensis* (the only specimen we have of the animal) is no longer thought to be an example of island dwarfism but rather because the specimen wasn't fully grown. Furthermore, the fact that we have also discovered giant stegosaurs like *Dacentrurus* (one of the biggest of its kind) and even giant sauropods like *Cetiosaurus* in the same localities shows that the dinosaurs found in Late Jurassic Britain were just as big as their more famous American counterparts, despite the narrator's insistence that large dinosaurs were a rare sight here. Other sites, like the famous Lourinhã Formation in Portugal, further prove that large dinosaurs were in fact quite common in the European isles. Notably, the latter site revealed that the apex predator trio of *Allosaurus*, *Torvosaurus*, and *Ceratosaurus* weren't just endemic to North America but also to Portugal, along with possible fossils of *Stegosaurus* and the massive diplodocid *Supersaurus*.
- Biomechanical studies have shown that skim feeding (as *Rhamphorhynchus* is shown doing) was not possible in known pterosaurs. *Rhamphorhynchus* itself is more likely to have hunted fish while swimming and diving (skim-feeding is also rare among seabirds to begin with; among extant birds, only the extremely specialized, and aptly-named, skimmers hunt this way).
- WWD was perhaps the last hurrah of sea turtle-like pleisosaurs in documentary media before the idea fell out of favor with the Turn of the Millennium. Plesiosaurs gave birth to alive newborns in water just like the fish-like ichthyosaurs; and it's now pretty much universally agreed that they could not crawl onto land because of their limb anatomy and the shape of their chest , not even the small ones, thus making them far more analogous to cetaceans.
- The episode implies that plesiosaurs reproduced on land (although that does raise the question if the producers thought the same of the gargantuan *Liopleurodon*...) when it states that "most sea reptiles return to the land to lay eggs". Plesiosaur reproduction was unknown at the time, but subsequent fossils have indicated plesiosaurs gave birth underwater like ichthyosaurs, but were k-type breeders similar to whales, and therefore likely cared for their young.
- *Rhamphorhynchus* has since been found to likely have been nocturnal while the closely related *Scaphognathus* was active in the same area during the day (an example of niche partitioning).

- The largest known pliosaurs were probably only around 12 metres or so at the most, and even that's pushing it. As detailed in the tie-in book *Walking with Dinosaurs: The Evidence*, the whale-sized *Liopleurodon* was based on an assortment of jaw and snout fragments from Oxford Clay, as well as one vertebra around 25 cm in width housed at the Peterborough Museum (the latter of which turned out to have come from a sauropod), which were interpreted at the time as stemming from pliosaurs reaching up to as 20 meters in length, with the main *Liopleurodon* of the episode being stated to be an unusually large specimen of a species that *on average* reaches 18-20 meters in length. Further complicating things, some taxonomic shifting down the line transferred the largest alleged *Liopleurodon* remains (attributed to animals reaching 8-11 meters), such as the massive "Cumnor mandible", to the related *Pliosaurus*, leaving *Liopleurodon* in the 5.5-7 meter range. Though it was still the biggest killer of its day before being replaced by (or possibly evolving into) the larger *Pliosaurus*.
- Additionally, it should have a fluke on its tail, as should the *Cryptoclidus*.
- It's now considered more likely that plesiosaurs such as *Cryptoclidus* swallowed stones to help grind up food items rather than for use as ballast; in some cases, the stones made up less than one percent of the overall predicted body weight of the animal, and so would have been of very little use to weigh the animal down.
- At least some ichthyosaurs could actually give birth to more than five pups at a time (up to eleven or more), and they came out head first. Most famous fossils purported to show mothers dying in childbirth are actually of pregnant ichthyosaurs who died before birth, and the fetuses dropped out during decomposition.
- The depiction of ammonites with an operculum is nowadays considered doubtful; unlike modern nautiluses, they probably didn't have any sort of lid. Most modern restorations also tend to make ammonites more colourful, similar to modern marine molluscs, rather than the greyish-brown which was the popular convention at the time (since it's been pointed out that the dull colour of the shell fossils don't usually correspond to the colour it was in situ).
- Although unnamed in the episode, supplementary material identifies the shark as *Hybodus*. Subsequent studies indicate *Hybodus* is a wastebasket taxon of various hybodont species; the species in the episode would nowadays probably be identified as *Asteracanthus*.

Giant of the Skies

- In 2020 YouTubers Ben G. Thomas and TREY The Explainer did an in depth review of the current inaccuracies and accuracies of the episode which can be found here

- The giant *Ornithocheirus* was based on a specimen now assigned to *Tropeognathus*. Likewise, during the 90s it was indeed believed that the large specimen (MN 6594-V) might have had a wingspan of 11-12 meters (though those were the highest possible estimates), but it was not properly described at the time. During its final description in 2012, workers estimated its wingspan at around 8.2 to 8.7 meters, smaller than the giant featured in the episode, but still quite a massive pterosaur, second only to the giant azhdarchids. Sadly, it was lost during a subsequent museum fire, preventing any further research.
- *Ornithocheirus* is portrayed with delicate, thin-membraned wings like those of a bat, that make it unable to fly while in the rain and easily warded off by a flock of tiny enantiornithine birds. Subsequent studies suggest pterosaur wings were much thicker and more complex in structure than bat wings, with separate layers of air sacs, fibrous tissues, muscles, and a strengthening, weave-like outer layer known as "actinofibrils". As for the supposed need to keep the wings from getting wet, the prevailing theory now is that fish-eating pterosaurs would *dive* into the water to catch fish, like gannets.
- The juvenile *Ornithocheirus* at the end is portrayed as being identical to the adults, but research on pterosaurs since has found that in most species, the juveniles were very different in appearance from adults because they held different ecological niches (a life history pattern shared by many non-avian dinosaurs, but basically nonexistent in modern birds and mammals).
- The *Tapejara* species featured has now been reassigned to *Tupandactylus*. We also now know that the head is too small and the males had a flat crest rather than a ridged crest.
- *Tropeognathus* and *Tupandactylus*, known from the Brazilian Santana Group, specifically the Romualdo and underlying Crato Formation respectively, are shown living 127 million years ago (middle Barremian), but the ages of Romualdo and Crato have subsequently been reinterpreted as early Albian (112-108 mya) and late Aptian (115-113 mya) respectively. The same Anachronism Stew is present with the sympatric *Anhanguera* in *Dinosaur Revolution*.
- While the *Iguanodon* model has aged much better than many others in this series, it still possesses very gracile forelimbs with relatively small thumb pikes. This was based on ⬨ the smaller *Mantellisaurus atherfieldensis*, which used to be classified as *Iguanodon atherfieldensis* until 2008. It's also an example of Mix-and-Match Critters, since the large size (stated to weigh 3 tons) of the European *Iguanodon* suggests that it's meant to be the type species, *Iguanodon bernissartensis*, which had much thicker forelimbs with more formidable thumb spikes .
- The "American *Iguanodon*" would probably be placed in the genus *Dakotadon* today.

    Addtionally, the North American *Polacanthus* is now seen as a separate taxon, *Hoplitosaurus*.

- The narrator also alludes to *Iguanodon* being a highly successful genus that was both widely distributed and lasted for tens of millions of years, but this was due to *Iguanodon*'s former status as a wastebasket taxon , when any mid to large-sized ornithopod fossils from the Early to Mid Cretaceous (even if they were very fragmentary) were lumped into it. Subsequent studies, however, found that the only fossils attributable to *Iguanodon* come from Western Europe (Great Britain, Belgium, Germany, and Iberia) during the Barremian and early Aptian (130-122 mya), and even then, many iguanodont fossils from the Early Cretaceous of Europe have been reassigned to different genera like *Hypselospinus*, *Barilium*, and the aforementioned *Mantellisaurus*.
- When it was first described in 1993, *Utahraptor* was only known from fragmentary remains and workers used its smaller but much better-preserved cousin *Deinonychus* to fill in the missing gaps, which resulted in *Utahraptor* usually being reconstructed as just a scaled-up *Deinonychus*. But subsequently, paleontologists discovered a block of sandstone containing several *Utahraptor* specimens along with a small iguanodont (theorized to be a "predator trap" akin to the famous La Brea Tar Pits). This breakthrough find showcased that *Utahraptor* was anatomically very different from smaller dromaeosaurs like *Deinonychus* and *Velociraptor*, and had a bulky body with relatively short hind legs and tail, making it the raptor version of a saber-toothed cat, and its jaw had a procumbent shape similar to *Masiakasaurus*.
- *Utahraptor* stems from the Yellow Cat Member unit of the Cedar Mountain Formation in Utah, which for the longest time was considered to be Barremian in age (the same age as the setting of the episode), despite some workers disagreeing. But in 2019, using advanced methods of radiometric and palynological dating, it was concluded that the Yellow Cat Member is indeed older than previous estimations, and that *Utahraptor*, along with sympatric dinosaurs like the ankylosaur *Gastonia* and sauropod *Cedarosaurus* lived during the early to mid Valanginian (139-134 mya).

- As mentioned in the book *Walking with Dinosaurs: The Evidence* and several other bits of supplementary material, the reason why *Utahraptor* was shown living in Europe was due to a theory that was floating around in the 90s, which suggested that Europe and North America were connected via a land bridge through Greenland during the Barremian, which allowed for easy intercontinental migration (akin to the faunal exchanges through the Bering land bridge during the ice ages). This was based on the apparent fact that other taxa such as *Iguanodon* and *Polacanthus* had fossil material from both Europe and North America. However, with the reclassification of the North American fossils as different genera, this theory has largely fallen out of favor.
    - In 2021, a (fragmentary) dromaeosaur called *Vectiraptor greeni* was described from the Isle of Wight, the same formation that contains *Iguanodon* and *Polacanthus*, but it was much smaller than *Utahraptor*. Some teeth from the same formation have been attributed to a *Utahraptor*-sized dromaeosaur (which some have tentatively attributed to *Vectiraptor* itself), but other workers believe that they come from a proceratosaur.
- Later studies suggested that most Mesozoic birds probably incubated their eggs by burying them like modern crocodilians or megapodes, rather than sitting on them (however, as portrayed in the show, at least some enantiornitheans *did* nest in colonies, so they got that right at least).
- The episode implies that pterosaurs went into decline during the Cretaceous due to being outcompeted by early birds. Not only did later studies go on to suggest that pterosaur decline was unrelated to bird diversity due to ecological overlap between the two groups being less than previously thought, the idea that pterosaurs declined at all is now in serious doubt. In fact, there's evidence to indicate that *pterosaurs* were reclaiming niches previously occupied by *birds* prior to the K-T extinction event.

Spirits of the Ice Forest

- Some argue that *Leaellynasaura* needs plumage. It also might have actually had a really long tail, although it's not clear if these long-tailed fossils belonged to *Leaellynasaura* or a different, but similar animal.
    - Interestingly, the tails lack ossified tendons. This may have allowed the dinosaurs (whoever they were), to roll the tail over their bodies during their sleep, like foxes do today.
- In 2011, a study suggested that the supposed large eyes of *Leaellynasaura* were actually just because it was a juvenile specimen rather than an adaptation for low-light conditions.
- Remains of simple burrows have been found in the area since then, suggesting that *Leaellynasaura* sought refuge underground to survive the cold, rather than making nests above ground. Similar structures have been attributed to other small ornithopods in Asia and North America (with three individuals of one species, *Oryctodromeus*, even being found preserved inside of its own burrow).

- The "dwarf allosaur" seen in this episode was based on a single ankle bone excavated from the Wonthaggi Formation (upper Aptian, circa 120-115 mya) in Victoria during the late 1980s, which was tentatively attributed to *Allosaurus*, or at least an allosaur of some kind, and the idea of a “dwarf polar allosaur” gained popularity during the 90s, mainly due to a lack of any other large theropod known from Cretaceous Australia, even though its classification was highly controversial among workers, due to its fragmentary nature. But in 2009, a whole decade after the series aired, a similar-sized but much more complete and related theropod was dug up from the Winton Formation in Queensland, dubbed *Australovenator wintonensis*, and its discovery led to the naming of a new, previously unknown lineage of tetanuran theropods called the megaraptorans. While their classification remains controversial (since they seemingly share characteristics of both allosaurs and coelurosaurs), based on *Australovenator* and related genera, we know that they looked very different from other large tetanurans, with elongated snouts and long arms armed with formidable claws ◇.
- Following the description of *Australovenator*, it was briefly considered possible that it and the mystery “polar allosaur” might have been the same creature, with the ankle bone being anatomically similar to the corresponding bone in *Australovenator*, and several BBC websites started referring to the polar allosaur as *Australovenator*. But in 2013, the Winton Formation was found to be late Cenomanian in age (circa 96-94 mya) instead of late Aptian-early Albian (115-110 mya) as was initially thought, making the ankle bone far too old to be assigned to *Australovenator*, but it most likely belonged to a similar animal, and further finds from the Eumeralla Formation (home of *Leaellynasaura*) showed that megaraptorans did indeed live in southern Australia close to the time of the Wonthaggi ankle bone.
- In regards to the polar allosaur, the narrator cites that “its kind is rare in the Cretaceous”. But that was not even remotely true, since a group of theropods called the carcharodontosaurs were incredibly successful during most of the Cretaceous, being apex predators on almost every continent, and during the Mid Cretaceous (when “Spirits of the Ice Forest” takes place), many gigantic forms like *Giganotosaurus*, *Carcharodontosaurus*, and *Acrocanthosaurus* roamed the Earth, and while their phylogeny was debated in the past, it’s now universally accepted that carcharodontosaurs were derived allosaurs, essentially being larger and more powerful versions of Jurassic taxa like *Allosaurus*, the opposite of what's shown in the episode. They only disappeared some 15 million years after the events of the episode.
- Much like moas, wetas are now believed to have flown into New Zealand long after it separated from Australia and Antarctica, rather than being isolated there from the beginning.
- The *Muttaburrasaurus* are shown as facultative bipeds similar to *Iguanodon*, but later research indicates that they were obligate bipeds and much more primitive in form. They're also depicted with thumb spikes, but shortly before the show premiered, the description of *Muttaburrasaurus* was revised after no evidence was found for any.

- We briefly see a flock of generic pterosaurs flying over the polar forest (it's the same *Pteranodon*-esque model we see in "Giant of the Skies"). While pterosaur fossils were known from Australia at the time, none were properly described. After WWD, we have named no less than four genera; *Thapunngaka*, *Mythunga*, *Aussiedraco*, and *Ferrodraco*, with the former three having lived right around the time the episode takes place. Furthermore, *Thapunngaka* and *Ferrodraco* turned out to be very similar to *Tropeognathus*, with the former growing nearly as large.

Death of a Dynasty

- The evidence for female *Tyrannosaurus rex* being larger than males is inconclusive at best, although considering that this pattern of dimorphism is seen in most large carnivorous birds as well as the most primitive birds today, it isn't improbable, there's just no direct evidence of it.
- Later papers suggest, contrary to most theropods, that most of *Tyrannosaurus* was covered in scales (small amounts of feathers are still a possibility), however, the scales themselves were tiny, more akin to those seen on a bird's foot than the thicker, lizard-style scales seen in the show. In reality, the scales would have been too small to see unless you were standing very close. The snout is also believed to have had thick keratinous scales on it, too, which are absent in WWD's depiction.
- Subsequent revisions of *Tyrannosaurus* anatomy indicate it was far more rotund than often depicted and its chest would've been much closer to the ground (as seen in a a more modern reconstruction , compared to WWD's version ◇). *Tyrannosaurus* is stated as weighing up to five tonnes, but most modern weight estimates suggest higher boundaries around seven to nine tonnes.
- Subsequent tyrannosaur fossils of juveniles indicate that young *Tyrannosaurus* had long, slender proportions with elongated snouts very distinct from the broad, blunt snouts of the adults, and they were probably fast and agile hunters even as chicks. They likely would've been independent from an early age, although this doesn't necessarily preclude some level of post-embryonic parental care.

- The giant pterosaur *Quetzalcoatlus* is shown as a fish eater hunting prey on the wing (the episode implies that it's normally a seagoing animal and happened to come in from the coast, seemingly ignoring that its remains are known entirely from semi-arid inland ecosystems that would've been hundreds of kilometres from the sea), while we now know it was actually stork-like in habits. In fact, it probably wouldn't have hesitated to eat juvenile tyrannosaurs, like the ones in the program! We now know *Quetzalcoatlus* actually had a much larger head and neck.

    Additionally, pterosaurs were probably *not* "on the decline" at the end of the Cretaceous. Indeed, azhdarchids like *Quetzalcoatlus* were among the most successful animals at the time. In March of 2018, the notion that only azhdarchids were left at the time was completely decimated, as several genera of pteranodontid and nyctosaurid pterosaurs were discovered in Morocco strata that were dated to 67 million years. Additionally, not all Maastrichtian pterosaurs (even azhdarchids) were giants.
- The body shape of the *Quetzalcoatlus* is more akin to the old reconstructions ◇ of the species with a short neck, sprawled posture, and *Pteranodon*-like crest, very different from the modern view , with a much flatter and frontal crest, erect stance, and massive head mounted on a long neck.
- The episode also states that *Quetzalcoatlus* had a wingspan of thirteen metres; this was actually conservative at the time, but nowadays, with better knowledge of azhdarchid anatomy, a maximum wingspan of about eleven metres is considered more likely.
- It's been theorized that *Triceratops* and *Torosaurus* (which were featured in *Death of a Dynasty* as seperate genera) are actually the same animal in different growth stages. However, research on this is still ongoing and has been doubted by some later studies.
- The accompanying book briefly mentions the possibility that *Anatotitan* is synonymous with *Edmontosaurus*. As of September 2011, this is the majority view. Also, in 2013 it was discovered that *Edmontosaurus regalis* had a crest of skin on its head like a rooster's, suggesting that *E. annectens* (the species that includes "*Anatotitan*") may have as well.
- *Anatotitan* is portrayed with a flat, ducklike mouth, though we now know that *Edmontosaurus* had a flat beak that sat at a 90 degree angle from its mouth, much like the one *Muttaburrasaurus* was given the previous episode.
- The episode also depicts *Anatotitan/Edmontosaurus* as being considerably smaller than *Tyrannosaurus*, but newer fossils indicate it was actually much larger, with specimens such as MOR 1142 and MOR 1609 suggesting lengths of over fifteen metres and possibly up to fifteen tonnes for some adults, far out-weighing the biggest *T. rex*.

- At the time the show came out, *Didelphodon* was mostly known from teeth, which were exceptionally large and robust for a Cretaceous mammal, leading to badger-like depictions, as in this episode. A skeleton was later found, revealing that it was shorter-legged, leaner, and semiaquatic, like an otter. The robust teeth were probably to crush freshwater crabs and molluscs. This is ironic, because *Didelphodon* is used in the show as an argument for dinosaurs "oppressing" mammals and keeping them from diversifying during the Mesozoic, but in reality it was an example of higher mammalian diversity in the Mesozoic than commonly assumed.
    - Interestingly, there is another mammal that lived alongside T. rex, called *Nanocuris*,which might fit the profile of the WWD *Didelphodon* a lot better, as it was a member of the deltatheridiids , who were likely active predators and might have even *preyed on baby dinosaurs*, as the skull remains of a juvenile troodontid from Mongolia sport bite marks made by a deltatheridiid.
- The generic raptor is simply identified as a "dromaeosaur", because at the time, there wasn't a named dromaeosaur species that was known to have existed alongside *Tyrannosaurus*; now there are known to be at least three (*Dakotaraptor*, *Acheroraptor*, and *Dineobellator*, with the last one being from New Mexico).
- *Ankylosaurus* is now considered to have been shorter in height and with a less arched, flatter back. It may have aimed for the tyrannosaur's tibia rather than its femur. Its armor was also a lot more complicated than in the show.
- The crew went to great pains to film on areas of Chile with no grass. Now it is known that grass was already present in the Late Cretaceous (whether it was present in large amounts in the Hell Creek region is still unclear however).
- It has been now revealed that hadrosaurs had horse hoof-like forefeet, with a spiked index finger.
- The episode sets the tone that even before the asteroid arrives, dinosaurs are already doing poorly due to increased global volcanism poisoning the environment with toxic fumes, and the meteor is more like the straw that broke the camel's back. However, this stance on dinosaur mass extinction is highly contentious, and many newer studies indicate evidence for a drop in end-Cretaceous dinosaur diversity brought on by mass volcanism is inconclusive at best. Notably, few other dinosaur documentaries even mention it. The next prevailing view is that an impact event was indeed the primary reason for their extinction and they were doing very well beforehand, which is currently the majority held view .
- The idea that the Hell Creek ecosystem was a barren wasteland with only patches of forest scattered across it is entirely incorrect, volcanism or not. We know from both the fossil flora and the abundance of small animals like mammals, birds, fish, turtles, and crocodiles that Hell Creek was a lush, alluvial flood plain environment much more akin to today’s Everglades, but with araucaria conifers and ferns in place of grass rather than the ash fields of Chile.

- Geologists place the end of the Mesozoic Era as being roughly 66 million years nowadays instead of 65.5 million, as is portrayed in the episode.

Walking With Beasts:

New Dawn

- Debatable with the brief shot of a tamandua, likely meant to represent *Eurotamandua* from the Eocene of Messel , which was initially identified as an anteater. Studies from 2010 indicate that it probably wasn't an anteater and quite likely it wasn't a xenarthran at all . However, the alternative is that it was a primitive, arboreal pangolin with no armor. This makes sense (since anteaters originated in South America while pangolins appeared in Eurasia, and other pangolins are known in Europe at this time) but also means that *Eurotamandua*, in the flesh, would look very much like a tamandua even if it wasn't a real tamandua. The use of a tamandua as a stand-in should be perfectly excusable. The use of a coati as a stand-in for the giant platypus *Steropodon* in WWD, on the other hand... not so much.
- Whether the robust beak of *Gastornis* was to crush large nuts or small animals has been a matter of debate since its discovery. WWB went with the animals and presented *Gastornis* as the top predator in the Eocene European jungle. However, the latest study on calcium isotopes found that *Gastornis*' data was more similar to herbivorous mammals and reptiles (such as dinosaurs). There goes the show's iconic line about the Eocene being a time when birds ate horses.[note] Near the end of their time in the early Pleistocene, the superficially similar terror birds, which *were* carnivores, did however eat horses. In addition, the idea of *Gastornis* being carnivores was already suspect, since the beak lacked a hook and its feet lacked claws. More likely creodonts (the order containing *Hyaenodon*), mesonychids, and terrestrial crocodilians such as *Boverisuchus* would have been the apex predators.

    Eggshells from France reveal *Gastornis* eggs were similar in size to cassowary eggs, while the one in the episode seems ostrich-size if not larger. Cassowaries lay three eggs or more at once.
- It's not completely agreed up whether leptictids hopped like modern kangaroos, or walked bipedally like theropod dinosaurs. A close relative of *Leptictidium*, *Leptictis* is currently believed to have walked rather than hopped, but differences between the skeletons make it insufficient evidence to suggest either way for *Leptictidium*.
- *Ambulocetus* most likely couldn't support itself on land , and was fully aquatic despite still having limbs.

Whale Killer

- In contrast to the agile, orca-like open ocean predator seen in the episode, studies of the skeleton of *Basilosaurus* suggest that it was actually quite restricted in terms of movement, unlike the smaller *Dorudon*, who was a diving, three-dimensional swimmer. The larger whale swam in a two-dimensional anguilliform fashion, since its vertebrae were hollow and likely filled with fluid, unlike in modern whales, which are solid, and the skeletal anatomy of the tail suggests that it had a small fluke, which would have aided only in vertical motion. Muscle attachments along the spine also imply that *Basilosaurus* had relatively weak muscles and could neither dive deep nor swim for extended periods. These characteristics point to an animal that only swam and hunted near the surface and/or in shallow water, while the show showed it being forced into shallow water from the open sea.
- *Andrewsarchus*, known only from a skull and a few fragments of bone, was assumed at the time the series was produced to be closely related to the mesonychids, and modelled after them. However, later phylogenetic studies indicate that it might have actually been a close relative of entelodonts and therefore might have been much less wolf-like than portrayed. Like entelodonts, it may have also been more omnivorous and not a pure carnivore.
    - And on that note, mesonychids most likely weren't the true ancestors of whales. Later studies have found whales to still be ungulates, but closer to the ancestors of hippopotamuses than more basal groups like the mesonychids (it helps that both hippos and whales are aquatic). Ironically, these two corrections have coalesced into *Andrewsarchus* being still a land-dwelling relative of whales, but in a different branch of the ungulate family tree than previously assumed.
    - The holotype hails from the Irdin Manha Formation, which turned out to be Mid Eocene in age (44-40 mya), not Late Eocene (39-34 mya), meaning it would not have been a contemporary of *Embolotherium*. The apex predators of Late Eocene Asia would have been hyaenodonts and entelodonts (like the ones seen in "Land of Giants").
- *Apidium* is now dated to the Oligocene instead of the late Eocene as portrayed in the show.
- It's been suggested that the horn-like bony growths on the nose of brontotheres like *Embolotherium* were not free-standing, but actually the anchoring point of a large, fleshy nasal cavity that acted as a resonating chamber (similar to the crests of hadrosaurs). Not all brontotheres would've had this, as there were other species that did have them free-standing and used for interspecific combat and defense.

Land of Giants

- Indricotheres were not completely invulnerable to predation, as bones from the Bugti beds in Pakistan have revealed tooth marks of bear-dogs and a 8-meter long crocodile, *Astorgosuchus bugtiensis*. However, even giant crocs could (at best) have only hunted young animals, while 10-15 ton mature adults were definitely off the menu.
- While paleontologists never expected *Paraceratherium* to behave like a carbon copy of African rhinos, this depiction became even less plausible after Prothero reviewed the group's biology extensively a decade later. One of the conclusions was that a mammal the size of *Paraceratherium* would be in permanent risk of overheating, so it would be mostly nocturnal or crepuscular, and spend the day in the shade, bathing, mud-bathing, or near water. Since indricotheres fed on tree leaves only, they would avoid depleting their food source by moving constantly from one forested area to another, which would not tire them due to their size, and might do yearly migrations like giraffes and elephants (but not modern rhinos). This would be specially true in desertic areas like the one shown in the episode. Ranging areas would be enormous and densities very low; to guarantee that mating happened at replaceable rates, the females may live in herds or family groups.

    Isotope data from central China is also consistent with indricotheres feeding mostly on riverine forests, even when the territory around was desert-like.
- There is some anatomical evidence to suggest indricotheres may have had a small trunk like a tapir instead of the pointed rhino-like fleshy lip the show used (although the latter is still plausible).
- Male indricotheres were found to have longer tusks than females, which at least strongly suggests that tusks were used in threatening or mating displays. This is not the case in the show where the threatening display is a combination of African rhinos and giraffes.
- Andrews originally restored "*Baluchitherium*" as a tremendously massive animal even by rhino standards, most likely as a way to make sure that *he* had found the largest land mammal of all time. The reconstructions lost weight through the 20th century, and this process continued after the show. Nowadays, some no longer believe it was the largest land mammal of all time but was surpassed by the elephant *Palaeoloxodon namadicus*, although it is still the tallest (and the line about being the largest land animal *since the dinosaurs* is still true).

- The *Hyaenodon* is described as being “as big as a rhino”, but no known hyaenodont approached the size of even the smallest extant rhino (the Sumatran rhino, which can still reach a whopping 800 kg). The largest known hyeanodont is *Megistotherium osteothlastes*, with an estimated weight of 500 kg, but it lived in Early-Mid Miocene Africa, not Late Oligocene Asia. The largest species of *Hyaenodon* proper, *Hyeanodon gigas* (only known from teeth and jaw fragments), is estimated to have weighed 250-378 kg, about the size of a tiger. The exaggerated size was likely based on outdated methods used for calculating the body weight of hyaenodonts, based on the proportions of modern carnivorans. This failed to take into account their unique proportions compared to modern carnivores (specifically their proportionally larger heads), leading to overestimates.

    Interestingly, in 2019, a close relative of *M. osteothlastes* was described, called *Simbakubwa kutokaafrika*, which was initially estimated to have possibly reached as much as 1.5 tons, thus making it the largest hypercarnivorous mammal ever found! However, those estimates were soon met with scrutiny, since they were obtained using the aforementioned questionable methods, and in reality, *S. kutokaafrika* was likely much closer in size to *H. gigas* (around 250-380 kg).
- The entelodonts notably suffer from shrink-wrapping, as their heads look like someone just draped skin over the bare skulls, with next to no soft tissue between them, and their teeth are shown to be exposed even when they have their mouths closed. In reality, an entelodont’s head would likely have been encased in a lot more flesh . The *Hyaenodon* too has its enlarged canines exposed (giving it a saber-toothed look), when in reality, they would have been tucked behind its lips.
- The entelodonts are described as cousins of pigs and the narrator even uses the popular moniker “hogs from hell”. At the time of the show’s making (and over much of paleontological history), entelodonts were classed as members of the Suina suborder, the same one that contains pigs, but studies made after the show's release have placed them as members of Cetancodontamorpha, whose only surviving members are hippos and whales. Interestingly, hippos were traditionally also classified as members of Suina prior to the advent of DNA studies.

    As mentioned before, *Andrewsarchus* is also classed as a member of Cetancodontamorpha, and is considered to possibly be a close relative of entelodonts, thus making it rather humorous in hindsight how different the show’s models for these two ungulates are, as conventional wisdom nowadays is that *Andrewsarchus* paid a stronger resemblance to entelodonts (to what extent is unclear).

- The reasons for *Chalicotherium* showing up in the Late Oligocene can be chalked up to it being used as a wastebasket taxon in the past. The genus is known from some very complete material but all of those stem from the Late Miocene-Mid Pliocene (10-3.5 mya), with the oldest known fossils of chalicotheriines (the knuckle-walkers) stemming from the Mid Miocene (16-14 mya), while the only chalicotheres confirmed to have lived around the end of the Oligocene being the more basal schizotheriines (non-knuckle walking chalicotheres such as *Ancylotherium* introduced later), like *Borissiakia* (the best fit for “Land of Giants"). Very fragmentary fossils from the Late Oligocene-Early Miocene of Eurasia were previously lumped into *Chalicotherium*, but those have since been deemed schizotheriines or *nomen dubia*, like “*Chalicotherium*” *pilgrim* (possibly a schizotheriine) and “*Chalicotherium*” *wetzleri* (now included in *Metaschizotherium*, also a schizotheriine).
- The opening for the episode states the indricothere as being the largest land mammal of all time, but a study in 2015 found that the extinct elephant species *Palaeoloxodon namadicus* may have gotten bigger by about five tonnes (17 tonnes for *Paraceratherium* vs 22 tonnes for *Paleoloxodon*). However, the study based this on two partial bones discovered and measured in the early 19th century, not from direct examination of these fossils, so it still requires further confirmation. Also the study found the largest *Paraceratherium* could have reached 17 tonnes rather than 15 as stated in the episode.
- Geologists now place the end of the Oligocene at 23 million years ago, instead of 25.

Next of Kin

- *Dinofelis* was not too slow to catch "fast prey" and did not rely exclusively on "slow prey" like *Australopithecus*. A 2002 study on calcium isotopes of fossil carnivores that lived alongside australopithecines found that their sampled *Dinofelis* primarily hunted grazing ungulates, leaving leopards, hyenas, and the smaller sabre-toothed cat *Megantereon* as the likelier to feed on primates. However, modern big cats generally tend to specialise in whatever prey is readily available and, sometimes, what prey their mother taught them to hunt. So, even if *Dinofelis* was not a specialist primate-hunter, individual *Dinofelis* could have been.

    Incidentally, *Megantereon* also had climbing adaptations that its larger, terrestrial descendant *Smilodon* didn't have. Which also makes the cat's behavior in the episode closer to what could be expected of *Megantereon*.[note] Being smaller, *Megantereon* could have hidden its kills in the treetops to save them from hyenas and *Dinofelis*, in the same way leopards do today to save them from hyenas and lions, though this is purely hypothetical.

- It's very likely that *Dinofelis* and other machairodontine cats with modest-sized canine teeth (like *Homotherium*) had them tucked behind their lips. Many modern felines such as tigers and especially clouded leopards have surprisingly large canines that are nonetheless hidden behind their lips. The only exceptions would have been *Smilodon* and other taxa with fangs protruding beyond the jawline.
- The *Deinotherium* model follows the theory that deinotheres had shorter trunks than elephants. This was based on the facts that deinotheres separated early from the proboscidean family tree, and that their skulls lack the attachment marks corresponding to some trunk muscles, which were interpreted as deinotheres lacking these muscles, and as a result having shorter and more primitive trunks than elephants. It was later found that elephants don't have these marks either, because the muscles actually attach to other muscles in the trunk rather than the skull. If deinotheres didn't have them, it could be because they had long, advanced, elephant-like trunks, rather than the opposite. Finally, the authors of the later study appealed to common sense: while deinothere necks are slightly longer than elephant's, their legs are also longer, and they are not better at kneeling than elephant legs are. This means that if deinotheres had trunks as short as depicted in the show ⬦, the animals would be nearly incapable of drinking without getting partially submerged in water. However, some paleontologists believe deinotheres still wouldn't have long trunks since their family was part of an order known as the Plesielephantiformes that diverged from other proboscideans as far back as the Paleocene, and propose that their method of drinking *was* by submerging in water similar to how modern moose drink. The debate is still going on, but it's most likely deinotheres would have had longer trunks than in the show.
- Musth likely has nothing to do with mating, but with helping elephants fight in times of scarcity. Musth-striken males will kill females rather than try mating with them.
- There is increasing evidence that *Australopithecus* is not an ancestor of *Homo* at all, but a more vegetarian offshoot from a common ancestor, that eventually led to the specialist vegetarian genus *Paranthropus*. The last common ancestor of *Australopithecus* and *Homo* might be *Ardipithecus* (named from fragmentary remains in 1995; a much more complete specimen, called "Ardi", was unveiled in 2009) or an even earlier genus like *Sahelanthropus* or *Orrorin*. In any case, the adaptation to bipedalism appeared already in the primitive East African jungle and was unrelated to its clearing and transformation into savanna. "Next of Kin" (as in Next *to our* Kin) still makes for a great description of *Australopithecus*, though.
- *Ancylotherium* is no longer the last surviving chalicothere: *Nestoritherium* and *Hesperotherium* survived in East Asia until the Middle Pleistocene less than one million years ago, and were contemporary with *Homo erectus*.

Sabre Tooth

- A rarity for the WW series, but the *Smilodon* species featured in the episode, *Smilodon populator* (one of the largest known felines), wound up being *undersized*. Here it's described as reaching 300 kg, which would have been a reasonable weight for an average-sized individual, but a huge skull described in 2020 from the Dolores Formation in Uruguay revealed that very large specimens could reach an estimated 436 kg, which would be comparable to an average-sized male Alaskan brown bear.
- *Smilodon* was a terrible runner and would not be able to chase prey in the manner shown, due to its short tail making it harder for it to turn during a chase, and its more muscular body making it less suited for running in a chase than lions and tigers. That said, S. *populator* had proportionally longer legs than S. *fatalis*, which implies that it was more adept at running. This makes sense, since the former often inhabited savannah-like environments (as shown in the episode), though it was still not a pursuit predator.
- Studies at the time stated the saber teeth were brittle and could break when they hit bone, which actually was shown in the episode with the *Smilodon* being very careful when eating carcasses. Later studies, however, have elaborated on this to explain their teeth weren't *that* brittle, and could still safely remove meat from carcasses. They could even eat much smaller bones, similar to what lions can do.
- If *Smilodon* lived in packs, they would not have a lion-like structure (1-2 or so males with a lot of females), due to males and females being similar sizes. Wolf-like packs have been suggested (1 main male/female pair, with a mixed group of other members), although the evidence for any sort of pack is thin.
- The species of *Smilodon* shown (*S. populator*) in the episode had not evolved yet when the show was set.
- At the time the episode was produced, scientists believed that sabertooths had displaced terror birds as apex predators with their arrival, hence their depiction as scavengers. However, it is now considered more likely that the terror birds were still able to remain as apex predators in competition with the sabertooths. Also, the species would have been *Titanis* in reality, but a theory presented at the time was that *Titanis* was a synonym of *Phorusrhacos*, which is mentioned in some supplementary material. Eventually it turned out that not many large terror birds were still around in South America by the time *Smilodon* arrived in the continent, as *Titanis* is more well known from being the sole North American terror bird, and would've instead coexisted with the older *Smilodon gracilis*, the earliest known *Smilodon*.

- The claim that terror birds survived until just before the arrival of humans in the Americas was based on the initial confusion regarding the age of the *Titanis walleri* fossils, which were first found underwater in the Santa Fe River and mixed through different sediments, alongside animals known to have survived until the Late Pleistocene, which led to speculation about how long the giant bird lasted. Around 2007, more precise dating of the bones based on the chemical signatures of minerals that had been absorbed into the bones during fossilization revealed the youngest *Titanis* fossils to be around 2 million years old (Early Pleistocene). Likewise, the youngest fossils of a large terror bird from South America (a tibiotarsus) was found in the lower layers of the Raigon Formation in Uruguay, dating to the Late Pliocene-Early Pleistocene (circa 2.5-2 mya), though it too was previously claimed to be younger. These two taxa represent the last known occurrence of giant phorusrhacids and put their extinction at around 2 million years ago. Some fossils of a small terror bird, similar to the 5-kg *Psilopterus*, from Uruguay might come from the Middle to Late Pleistocene but their age remains controversial.
- It's depicted as incredibly tall and lanky, with a very long neck and legs, coupled with a small head, basically resembling a 3-meter seriema. But now it's known that giant phorusrhacids were stockier animals with large, ax-like heads used for striking down prey and it's therefore unlikely that any terror bird reached 3 meters in height, including the largest known species, *Kelenken guillermoi*, who is estimated to have stood between 2 and 2.5 meters tall. *Titanis walleri* in particular turned out to have been even stockier than its closest relatives ◇, the polar opposite of what is shown in the episode.
- Though hard to see and not explicitly referenced, the *Phorusrhacos* model has a single finger-like claw per wing. This was based on a theory about *Titanis*'s unusual joint articulation mixing flexing digits with relatively rigid wrists that would not have allowed the hand to fold back against the arm as in other birds, which was interpreted as the wings supporting some type of re-evolved clawed, mobile hand similar to the hands of non-avian theropods. However, this was debunked about 4 years after the show came out, when the same articulation was discovered in the closest living relatives of the terror birds, the seriemas, who don't have any kind of wing claws.
- Although it was suggested at the time by some that *Megatherium* and other giant ground sloths may have occasionally hunted or scavenged, this idea was always a fringe one due to the lack of evidence (and extensive counter-evidence, such as the lack of carnassials in ground sloths and the fact that no animal remain has been ever found in ground sloth dung - which is a very abundant fossil, by the way). A relative of *Megatherium*, the bear-sized and sympatric *Mylodon*, was actually described as an omnivore and scavenger in a 2021 paper, based on isotope analyses, though *Megatherium* and several other ground sloths came out as herbivores based on similar isotope tests, and it's unlikely that the smaller *Mylodon* would have tried stealing the kill of a *Smilodon*, let alone a group of them.

- *Megatherium* probably wasn't as hairy as commonly portrayed, due to its large size and the fact that it lived in a warm climate. If it was shaggy as in the show, it would have overheated.
- *Macrauchenia patachonica* was actually a very imposing animal ⬦, similar in size to a moose but more stocky in build , weighing up to a ton, in contrast to the rather dainty animal depicted in the episode.
- After a century and a half of mystery, DNA finally revealed litopterns like *Macrauchenia* were very distant relatives of perissodactyls and true ungulates as a result.
- Paleoartistic reconstruction have also increasingly moved from showing *Macrauchenia* with a long, almost comical trunk to a more boring moose-like snout, though there is still no conclusive evidence for either.
- Glyptodonts such as *Doedicurus* would have had a “cap” of osteoderms to protect their exposed heads.

Mammoth Journey

- Ancient DNA studies have found that Europeans retained dark skin tones until the arrival of paler people from the Middle East and Siberia about 7,000 years ago. This means the episode's *Homo sapiens* should be of noticeable darker complexion than the Neanderthals, some of whom were red haired.
- The interpretation of the Jersey cliffs as killing sites where Neanderthals drove mammoths over the edge and butchered them below has been questioned . The mammoth bones might have just rolled downhill and accumulated there naturally, long after their owners died. However, due to the presence of tool marks in the bones, it is still possible that the mammoths were killed by Neanderthals in some other way.
- Nowadays it's known that Neanderthals were not shorter than *H. sapiens*, and were more or less the same average height.
- More refined radioactive dating methods suggest Neanderthals became extinct closer to 40,000 years ago than 30,000 years ago, as was generally believed when the show was made.
- The introductory opening of the episode states that there were two different types of humans alive at the time (Neanderthals and Cro-Magnon), but a third variety of ice age human was identified in 2010, known as Denisovans, which may have survived as late as 14,500 years ago. However, they are still very poorly understood and not known to have existed in the region the episode is set.

- The discovery of frozen cave lion hair, and also complete cubs, in Siberia in 2016-2017 showed cave lions had largely the same plain sandy coat as modern African lions, only slightly longer and yellowish at most. The theory that they were white haired or turned white in the winter always had a lot of Rule of Cool involved, anyway. Funnily enough, it was also discovered (in 2003) that the saber-toothed cat *Homotherium* survived in Europe until at least 28,000 years ago, so they could have had a better result disguising their *Dinofelis* model as that, than trying to pass it as a cave lion.
- Mammoth trunks in the show are based on their closest living relative, the Asian elephant, which only has one "finger". It is now known that mammoths had three fingers, and also that the sides of the trunk were expanded near the tip, allowing to warm it by rolling the trunk over itself.

Walking With Cavemen:

Blood Brothers

- The status of *H. habilis* as a human ancestor is slowly eroding with each new discovery. It is possible toolmaking was more widespread than previously believed, and that *Homo ergaster*-type hominids evolved earlier than previously thought and thus not from *H. habilis*.
- It's been suggested that there was just one *Homo* species in this time, that was a very plastic one (think dogs rather than people) and as a result, *H. rudolfensis* and *H. habilis* were the same species (maybe even *H. ergaster*, as well - but this is extremely far from the consensus).

Savage Family

Gigantopithecus probably wasn't actually over ten feet tall; a 2017 study of its jaw fossils (one of the only parts of the animal actually known), suggest it more likely had a large and robust jaw for its size. It certainly still would have been an enormous ape, but it was more likely a bit larger than the largest gorillas rather than a nigh-legendary three-metre plus high colossus.

The Survivors

- It's been argued that the *H. heidelbergensis* of Atapuerca's Pit of Bones are not actually *H. heidelbergensis*, but early Neanderthals. If true, *H. heidelbergensis* should probably be considered as existing before 500,000 years ago only (the approximate age of the Pit of Bones remains).

- The "*H. heidelbergensis* not caring for their dead" bit was taken from *H. georgicus*. The type locality of this species was interpreted later as a sabertooth cat den. Maybe they could not bury *these* dead because they were hunted by cats and irretrievable. Or maybe they really didn't care about their dead. In any case, the premise flies on the face of extensive body disposal by hominids at the Pit of Bones, unless you assume the Pit of Bones' hominids are not *H. heidelbergensis*.
- On a similar note, the idea that imagination is what distinguishes modern humans from our ancestors came from the fact that no signs of art from other humans species had been found. Since then, it's been found that Neanderthals carved artful objects and decorated them with pigments.

Walking With Monsters:

Water Dwellers

- The *Anomalocaris* doesn't have the segmented body and cephalic plate on its head it's now believed to have had; rather bizarrely, the show's portrayal seems to have a single, solid, unsegmented plate covering its entire body. The species of *Anomalocaris* which the show based its portrayal on (previously known as *Anomalocaris saron*) is now known to have been a chimera of two different dinocaridid species and subsequently named *Houcaris* (the great appendages) and *Innovatiocaris* (for the rest of the body), and the former was part of a group of *filter-feeding* anomalocarids.

    Although a popularly depicted predator-prey relationship for a while, the idea that *Anomalocaris* fed upon trilobites is questionable now due to subsequent studies on the structure of its mouthparts and lack of wear suggesting that it wouldn't have been gnawing through their hard shells. More likely, *Anomalocaris* specialized on soft-bodied prey animals, such as worms. Previous evidence for trilobite predation, such as bite-marks and coprolites, are now considered to have come from the related dinocaridid *Peytoia* or giant trilobites, such as *Redlichia*.
- The oversized, 3-meter *Pterygotus* was likely based on the larger and closely related *Jaekelopterus rhenaniae*, which was sometimes included within the *Pterygotus* genus. However, *Jaekelopterus* turned out to have inhabited brackish waters instead of the sea, while no similar-sized pterygotid has been found in marine deposits. It also received a slight downsize, at 2.6 meters in length including the chelicerae.

- The Giant Spider in the Carboniferous was based on *Megarachne*, which ultimately turned out to be eurypterid ("sea scorpion") rather than spider. This was actually an error found out during production, but at that point it was too late to change the model (since the story hinged on *Megarachne* being a spider), so they just avoided naming the specific animal, opting instead to calling it a generic "Mesothelae", a basal suborder of spiders that evolved in the Carboniferous and survives today with only one extant family, the liphistiids.
- *Arthropleura* is now considered to be a true millipede rather than simply a distant relative of the group.
- There is increasing evidence to suggest that while increased oxygen in the air may have been a factor, giant land arthropods were able to exist primarily, or at least heavily, due to lack of competition from tetrapods, which were still just beginning to free themselves from the water. The giant land arthropods such as *Arthropleura* declined and became extinct the moment the land-dwelling reptiles started to produce large-bodied forms and provide serious competition. Giant flying insects continued to exist into the Permian and Triassic periods, and perhaps not coincidentally, became extinct just as the first flying vertebrates appeared (the pterosaurs).

Reptile's Beginnings

- The lineage that gave rise to mammals split to the one that gave rise to reptiles and birds before those developed the reptilian scales. The show represents perhaps the first time that *Dimetrodon* and its herbivorous "twin" *Edaphosaurus* have skins similar that of modern hairless mammals, instead of the classic scaly one. However, some think now that they would have the skin texture of a salamander, and the belly of a fish.
    - Surprisingly, *Dimetrodon* may have been nocturnal.
    - A study in 2012 suggested that in at least some *Dimetrodon* species, the sail may not have extended all the way to the very tips.[note] The species examined was *D. gigashomogenes*, while the species probably portrayed in the show is *D. teutonis* (but depicted inaccurately as being huge, while the real animal was the smallest known *Dimetrodon* species at less than a metre in length)
    - Interesting to note that the giant, Angry Guard Dog-looking Gorgonopsid from the show has scent glands (a typical mammalian feature).
- The German *Edaphosaurus* featured in the episode is probably based on a little-known *Edaphosaurus* species known as "Edaphosaurus" *credneri*. However, a 2019 study found this species to be an indeterminant species of edaphosaurid and considered it a *nomen dubium*, that may or may not be an *Edaphosaurus*. Other European *Edaphosaurus* were classified in different genera like *Remigiomontanus* and *Bohemiclavulus*.

Clash of Titans

- The armoured plant-eating near-reptile *Scutosaurus* probably wasn't the ancestor of turtles. Later research suggests that the latter were closer to modern reptiles than to *Scutosaurus*.
- The series depicts its gorgonopsid as being hairless and the narration states that fur has not evolved yet, but fossils described in 2015 found in the Late Permian of Russia (the exact time and location the specific episode is set) found direct evidence of hair. Whether the hair came from a gorgonopsid is unknown, but it's clear some sort of therapsid at the same time already did have fur.
- The end of the Palaeozoic is more precisely dated to 251.9 MYA rather than 250 MYA as depicted in the episode.
- *Euparkeria* wasn't anything close to the "dinosaur ancestor" that the program makes it out to be. Not only did it evolve its bipedal gait independently from dinosaurs, it was more related to basal archosaurs, a group containing multiple major groups of reptiles other than dinosaurs. It was equally as related to crocodiles and pterosaurs as it was to dinosaurs.
- A 2023 study concluded from *Euparkeria*'s anatomy that it was not bipedal and was strictly quadrupedal, unable to rear up even for short periods because it was far too top-heavy. Archosaur bipedalism must have evolved some time later after the Early Triassic.

The Ballad of Big Al

A study on the life history of Big Al presented at the 2022 SVP meeting indicates that Al actually lived until at least sixteen, rather than dying at six as shown. Tissue structures found in the medullary cavities also suggested that Al may have been female and recently laid eggs at the time of death, rather than Al being depicted male and failing to attract a mate as depicted in the documentary.

Chased by Dinosaurs:

Land of Giants

- This special portrayed the largest land animal of all time, *Argentinosaurus*, being hunted by the largest land predator, *Giganotosaurus*. Both have been supplanted since then: New evidence found that *Spinosaurus* was the biggest land predator (though it was partially aquatic), while *Argentinosaurus* has been surpassed in length by a specimen of *Barosaurus* described in 2016. (*Argentinosaurus* is still heavier, though).[note] Even before *Argentinosaurus* was described its estimated size and weight was surpassed by those attributed to *Amphicoelias* and *Bruhathkayosaurus*. However, the record size of *Amphicoelias* was based on a single partial vertebra that was lost shortly after it was described by Cope in 1878, and a 2018 study suggests it was actually classified as a different type of sauropod than it really was (a diplodocid versus a rebbachisaurid, which are known to have very tall vertebrae), resulting in a bloated total body length due to differing proportions(sixty metres versus thirty metres). meanwhile the estimated dimensions of *Bruhathkayosaurus* were never peer-reviewed and published (and since the type fossil was later lost in a moonsoon flood, no further study can be made on it) with some suggesting it was actually misidentified petrified wood. The accuracy of both original descriptions has been questioned. Evidence of other sauropod species exceeding *Argentinosaurus* in size still exists however.
    - Funnily enough, later studies found the largest *Tyrannosaurus* were probably heavier than the largest *Giganotosaurus* by one or two tonnes, and a contemporary sauropod that lived alongside *Tyrannosaurus*, *Alamosaurus*, reached similar sizes to *Argentinosaurus*, from fragmentary remains discovered in the early 2010s.
- *Giganotosaurus* did not live at quite the same time as *Argentinosaurus*, although its close relative, *Mapusaurus* (whose fossils were initially attributed to *Giganotosaurus*), did, as the latter two both hail from the Huincul Formation. Likewise, *Giganotosaurus*, which hails from the underlying Candeleros Formation, lived alongside a still-unnamed but equally massive cousin of *Argentinosaurus*. So the predator-prey dynamic is accurate, but the specific pairing isn't.
- *Argentinosaurus* is portrayed as weighing slightly over ninety tonnes, which was actually conservative for the time, since some put at around one-hundred tonnes. Subsequent weight estimates suggest slightly lower mass ranges of between 75-85 tonnes, although it's still up for debate.
- *Argentinosaurus* would have looked different than the *Saltasaurus*-like design in the show; giant titanosaurs are now known to have longer necks and upright-slanted postures similar to *Brachiosaurus*.

- When Nigel initially sees a young *Argentinosaurus*, he says that it's unmistakable what species it is. This statement is probably because *Argentinosaurus* was, at the time, the only sauropod species conclusively identified from the Huincul Formation. Four other sauropod species have since been described, making the statement that it can't be mistaken for anything else shakier. He says the same thing for *Giganotosaurus*, but two large carcharodontosaurids have been identified from the Huincul Formation; as noted above, *Giganotosaurus* itself is ironically not one of them.
- *Giganotosaurus* is portrayed as briefly being able to chase a speeding car and suggested in supplementary material as being able to reach speeds of over thirty miles per hour. Later bio-mechanical studies on the running speeds of large theropods found it would have been impossible for them to run at high speeds, or possibly even run at all (that is, having a stride where both feet are off the ground at the same time for most of the stride) because they were so heavy their footfalls would have broken their legs, even if they had enough muscle mass to propel their massive bodies so quickly.
- Like any 2000s-2010s portrayal of *Sarcosuchus*, it's depicted as a 12-meter giant. Those often cited estimates were originally obtained by Paul Sereno in 2001 based on the head-to-body ratio found in extant crocodilians (ranging from saltwater crocs to the gharial). But since *Sarcosuchus* is not a member of Crocodilia and represents a far more basal crocodylomorph, the notion that "Super Croc" had the exact same proportions as its closest living relatives has faced more and more scrutiny. Subsequent studies, using the length of the femur, have yielded a smaller size of 9-9.5 meters, and different studies, based on the width of the skull, have produced the same results. Thus it would seem that *Sarcosuchus* was marginally smaller than *Deinosuchus* (which is thought to have reached at least 10.5 meters at its largest).
- A biomechanical study cast doubt on the ability of *Sarcosuchus* to roll over like modern crocodiles. Though the authors are cautious in this regard, the implication is that *Sarcosuchus* was a strict fish eater and did not attack drinking animals on the shore, like modern gharials (similarly long snouted). *Deinosuchus*, seen in WWD and *Prehistoric Park*, did not have such problems.
- The South American *Iguanodon* is now named *Macrogryphosaurus*, which, similar to *Giganotosaurus*, did not live at the same time as *Argentinosaurus*, although unidentified iguanodont fossils are known from the Candeleros and Huincul Formation.
- Later studies suggest that *Pteranodon* caught fish by diving into the water and swimming for their prey rather than snatching it up on the fly.

- *Pteranodon* fossils are known exclusively from the Niobrara Chalk and Pierre Shale of Late Cretaceous North America (88-80 mya) but historically, some fragmentary pterosaurs from the Mid Cretaceous (110-100 mya), such as the American *Bennettazhia* and British *Ornithostoma*, along with the Late Cretaceous Russian *Bogolubovia* were also attributed to *Pteranodon*. The latter two would have also suggested that the genus was more widely distributed, along with some more fragmentary material from the Late Cretaceous of Japan and Norway. However, the geologically older *Bennettazhia* and *Ornithostoma* were already seen as separate taxa by the Turn of the Millennium, and no pterosaur material attributed to *Pteranodon* was ever found in South America.

The Giant Claw

- The cast of the episode wouldn't have all been contemporaries in real life. *Therizinosaurus*, *Tarbosaurus*, *Mononykus*, and *Saurolophus* all come from the mid Maastrichtian Nemegt Formation (which gets namedropped by Nigel, meaning it's the episode's setting), which overlies the early Maastrichtian Barun Goyot Formation, and it, in turn, overlies the late Campanian Djadochta Formation (which houses *Velociraptor* and *Protoceratops*). To complicate matters, velociraptorine and protoceratopsid fossils from the intermediary Barun Goyot Formation have subsequently been reassigned to separate genera (*Kuru* and *Shri*, and *Bagaceratops* respectively), which widened the age gap. Nemegt did house a medium-sized dromaeosaur (and possible velociraptorine) called *Adasaurus*, but no protoceratopsid fossils are known from the site. Furthermore, Nemegt and Djadochta turned out to be quite different biomes, with the former being an alluvial plain and thriving with large dinosaurs, while the latter was more arid and desert-like (complete with sand dunes), and mainly housed small dinosaurs.
- Feather issues aside, *Velociraptor* was likely nocturnal.
- No trace of *Therizinosaurus* skin has been found, but the fact that its human-sized relative *Beipiaosaurus* had a complex feather cover makes it likely that *Therizinosaurus* had one too. The result looks like a cross between a goose and a ground sloth, much different from the show's naked model. Then again , given that *Therizinosaurus* was much larger and far more derived than *Beipiaosaurus*, it's possible that it, as well as the similar-sized and sympatric *Deinocheirus* had very little to no feathering, due to inhabiting warmer climes and their smaller surface-to-weight ratio. This would mirror the situation between the basal, feathered tyrannosaurs (*Dilong* and *Yutyrannus*) and their larger and more derived relative *Tyrannosaurus rex*, who has evidence that it was mostly, if not entirely scaly.

- The pterosaurs that are occasionally shown are identified by supplementary material as *Azhdarcho*, the first azhdarchid ever described. But Azhdracho hails from the Turonian-aged Bissekty Formation (92-90 mya), and actually coexisted with much smaller forerunners of the giant dinosaurs found at Nemegt, such as *Levnesovia* and *Timurlengia* (a basal, small-bodied hadrosaur and tyrannosaur respectively). Its inclusion in the episode can, once more, be chalked up to wastebasket taxonomy, as workers once assigned many small-sized azhdarchid fossils from the Upper Cretaceous to the genus before we learned about the true diversity of the group. In 2017, the discovery of cervical vertebrae revealed the presence of a very large azhdarchid at Nemegt , similar to *Hatzegopteryx*, though smaller ones were likely present as well, since both large and small taxa are known to have coexisted in Europe and North America during the Late Cretaceous.

Sea Monsters:

Dangerous Seas

- The enormously long-necked *Tanystropheus* was portrayed as capable of losing and regenerating its tail like a lizard. In the past it was indeed suggested by palaeontologist Rupert Wild[note] who also thought that *Tanystropheus* was closely related to lizards - nowadays it's generally considered to be more closely related to archosaurs than to lizards that this creature was capable of autotomy, but other scientists who studied its fossils didn't find evidence for that. It has also been portrayed as an accomplished swimmer, but we don't know for sure if it really was such - its body-shape was all but hydrodynamic, and some think *Tanystropheus* was a shore animal who used its neck as a fishing rod , catching small prey a bit like a heron; the show's portrayal still has adherents , however. Interestingly, the very similar *Dinocephalosaurus*, which was unambiguously a true swimmer, was discovered the same year the special premiered.
- In the accompanying book there is a Deleted Scene where female nothosaurs (primitive Triassic sea reptiles related to the more famous plesiosaurs) leave their eggs on the beach at night (see What Could Have Been on the Trivia page). However it turns out that nothosaurs might have been viviparous .
- *Cymbospondylus* is portrayed in the episode as being about 10 metres in length, which was reasonable at the time of the episode, but in 2021 a much larger species of *Cymbospondylus* was discovered known as *C. youngorum*, which may have been over 17 metres in length.
- *Dunkleosteus*' tooth-like extensions of its armor were later discovered to have been actual teeth that merged together. It also would likely have had lips covering them.

- *Arsinoitherium*, a relative of elephants that convergently resembled a rhinoceros, was probably more terrestrial than shown. It was discovered later that it also lived in inland rainforests in Ethiopia and actually survived there for longer than in Egypt; *Arsinoitherium* lived in mangroves, but it wasn't a mangrove *exclusive* as implied by the show.
- A study presented at the 2022 SVP and published in early 2023 suggests that the traditional size estimates of *Dunkleosteus* and other large placoderms are inaccurate and greatly embellished. It found *Dunkleosteus* was probably much shorter and more compact than previously thought, only about four metres long and less than two tonnes in weight (making it about the size of an average great white, but much heavier) instead of the ten-metre long, five-ton monster presented in the episode.

Into the Jaws of Death

The show was made in 2003, and as a result missed out on the discovery of *Livyatan melvillei* . Its fossil was discovered in the same area as the *C. megalodon* episode, and had they set it just a bit earlier, both of these "monsters" would have appeared. Also of note is the fact that period had even more large marine carnivores than the Cretaceous.

To Hell..... and Back?

- *Leedsichthys* would have had a more smooth head than its bone-plated portrayal in the show. Also, careful examination of its size range puts it at around 16 meters and 40 tons as opposed to 30 meters and 150 tons. This would make megalodon the largest known fish of all time, although *Leedsichthys* is still the largest known ray-finned fish ever.
- The *Metriorhynchus* species that coexisted with *Leedsichthys* and *Liopleurodon* was reclassified in 2020 as a new genus, *Thalattosuchus*.
- *Liopleurodon* is identified as the largest carnivorous reptile to have ever lived. Aside from the aforementioned revisions about pliosaur size, just one year after the series premiered a gigantic Triassic ichthyosaur was described known as *Shonisaurus sikanniensis* (although it's sometimes considered a species of *Shastasaurus*) which, at 21 metres in length, was far larger than any pliosaur or mosasaur. Fragmentary fossils of related animals suggest even larger sizes, possibly up to 26 metres in length, about the same size as the *Liopleurodon* is as depicted in the series. Although, since it was toothless and dolphin-like in shape, it wouldn't have been quite as fearsome-looking as a pliosaur or mosasaur.

- A number of mosasaur fossils have been found with shark like tail impressions (one long fin, one short fin). These fossils, and various other arguments, suggest that most or all mosasaurs would have looked more fishlike than the ones shown on the show. This, combined with the fact that it was warm-blooded, would have made it an even faster, more active hunter and give it access to polar regions.
- The largest mosasaurs probably didn't get as large in reality as they were portrayed because of this, as they would have had a more compact body shape. Lengths of between forty and fifty feet are considered more likely for the largest mosasaurs such as *Mosasaurus* or *Tylosaurus*.

The Complete Guide to Prehistoric Life:

- The *Pterygotus* entry states that sea scorpions' closest living relatives are horseshoe crabs, which was the traditionally held view, but a 2013 study found they were actually sister taxon to arachnids.
- The *Plateosaurus* entry states that prosauropods did not evolve into sauropods, but later studies have found the the traditional idea was correct that prosauropods really were the director ancestors of sauropods and the group is paraphyletic.
- The *Placerias* entry suggests that competition with herbivorous dinosaurs may have led to the decline of dicynodonts through competition. However, a large dicynodont was described in 2018, dubbed *Pentasaurus*, that coexisted with numerous species of large prosauropods, seemingly refuting this idea.
- Ammonites are stated to last been known from just before the K-Pg boundary, but a small number of ammonite fossils have since been identified dating from the early Danian, just after the Mesozoic Era, making it likely a few survived the mass extinction at the end of the Cretaceous, but were a "dead clade walking" and perished very soon after.
- *Ophthalmosaurus* is stated to have been found in South America as well as Europe. This is probably because the South American ophthalmosaurid *Mollesaurus* was, at the time, sunk into *Ophthalmosaurus*.
- *Metriorhynchus*' range is stated to include South America; fragmentary fossils from the continent were identified as belonging to the genus in 2000, but numerous subsequent studies have failed to find them as being conclusively *Metriorhynchus*.
- *Othnielia* and *Leaellynasaura* do not appear to be ornithopods, but more primitive ornithischians. Both are also identified as "hypsilophodontids", a group now considered to be a wastebasket taxon of various small ornithischians.
- *Tapejara* (now known as *Tupandactylus*) is described as being a carnivorous fish eaters. *Tapejara* is now speculated to have been a hornbill or toucan-like fruit-eater or omnivore, while *Tupandactylus* is thought to have been a ground-dwelling raptorial predator.

- *Velociraptor* is stated to killed its prey by slashing at it with its retractable foot claws. Subsequent studies have indicated it probably couldn't slash and was more likely used for clinging to and pinning prey like modern hawks or falcons do.
- The *Protoceratops* entry states that the origin of "ceratopsids" (probably meaning the broader group, ceratopsians) are mysterious, and they may have evolved from heterodontosaurids. Fossils of Jurassic ceratopsians are now known, making their early evolution much more well-known. Interestingly, their sister group, the pachycephalosaurs, which is still mysterious, have been suggested to have evolved from heterodontosaurids since then.
- The discovery of a four-chambered *Thescelosaurus* (strangely, referred to as a hadrosaur) heart is referenced for evidence of dinosaurs being endothermic. Subsequent studies showed this supposed heart was just a build-up of minerals during fossilization and had nothing to do with a heart. In any case, the argument that dinosaurs had four-chambered hearts is moot with or without it since modern birds and crocodilians both have one, so it's almost certain non-avian dinosaurs did too.
- The book repeatedly refers to dinosaurs as cold-blooded, such as in the *Leaellynasaura* and *Argentinosaurus*, and thinking of the idea of dinosaur endothermy as controversial.
- The entries for *Velociraptor* and *Therizinosaurus* poo-poo the idea of feathers for them (saying there's no actual proof) in a futile attempt to defend its scaly portrayals of the species. This would be a much, *much* tougher position to defend by the 2010s due to how much direct evidence of feathered coelurosaurs, of even large species, there is now.
- *Elasmosaurus* is stated to have also inhabited Russia and Japan, but these species are now considered to be either indeterminate elasmosaurid species for the former and classified as *Futabasaurus* in 2006 for the latter.

- There actually isn't any evidence that terror birds like the *Phorusrhacos* in the program had meathook claws on their wings. That idea came from an observation that one species, *Titanis*, had a very rigid wrist, suggesting the presence of some kind of digit. In 2005 it was pointed out that the birds' closest living relatives, seriemas, have the very same wrist, but no claws of any kind. However, seriemas *do* have a dromaeosaur-like "sickle claw ⬦" on their second toe, suggesting that terror birds may have had that instead. It should also be noted that most birds do have some kind of claw or spur hidden under their wing feathers, but nothing like the flexing, slashing finger shown in the book's restoration.
    - Likewise, the book treats the Pliocene to Early Pleistocene-aged, North American *Titanis* as a synonym of the Mid Miocene, Argentinian *Phorusrhacos* (even calling the former a “redundant name”). Nowadays, *Titanis* is very much universally regarded as a separate genus from *Phorusrhacos*, not just due to the massive temporal and geographic gap between them, but also because *Titanis walleri* is now known to have been shorter and stockier in build than *Phorusrhacos longissimus*. This tidbit also explains the gratuitous Anachronism Stew in “Sabretooth”.
    - The book states that terror birds may have died out as recently as 15,000 years ago, referring a 1995 study which suggested this from circumstantial evidence. This was refuted in subsequent studies that indicated the large terror birds died out close to two million years ago, and there's no evidence otherwise.
- *Entelodon* was not as closely related to pigs as was believed. It is now thought to be closer to whales and hippos, though as pigs were artiodactyls as well, it makes them a bit close, but still distant.
- Megalodon is identified as a *Carcharodon* species (the same genus that the modern great white belongs), but subsequent studies place it in the extinct genus *Otodus*.
- The book states that the latest research rules out the possibility the Neanderthals and modern-type humans interbred, but virtually all subsequent research from 2010 on from sequencing modern human and Neanderthal DNA has indicated the exact opposite, that they interbred extensively and nearly all living humans have Neanderthal DNA.
- The last entry in the book is the then-recently discovered *Homo floresiensis*, which was initially found to have survived very recently, said to be died out only 13,000 years ago. Closer examination of its fossils pushes back the last known *H. floresiensis* fossils to a considerably older age of 190,000 to 50,000 years ago.

- The Tree of Life at the end has numerous errors aside from those already stated regarding the classification of various groups:
    - Basal archosaurs are noted in brackets as "thecodonts", a group now known to be a wastebasket taxon and since discarded from common use due to being unhelpful and misleading.
    - Anomalocarids are stated to have died out in the Cambrian, but fossils of anomalocarid species have since been found in subsequent time periods, and they survived up until at least the Early Devonian.
    - Placoderms are shown dying out at the end of the Devonian, but we now know that modern jawed fish descend from them, so they never really died out.
    - Non-mammalian cynodonts are shown to have died out in the Early Jurassic, but they are now known to have survived until at least the Early Cretaceous, possibly up until the K-Pg boundary, or even into the Eocene if gondwanatherians are actually non-mammalian.
    - The mammal chart is utterly nonsensical by modern standards, as it just shows various placental groups erupting willy nilly from an enigmatic common ancestor rather than accurately depicting the relationships between the groups.
        Additionally, the group includes "insectivores", "creodonts", and "lepticids", groups with have since been found to be wastebasket taxa, the latter two being probably paraphyletic. Lepticids are also shown as placental mammals, but some studies find them as non-placental eutherians.

Walking with Dinosaurs 3D

- Just after they finished the *Gorgosaurus* models, *Yutyrannus* (a feathered tyrannosaur) was found, although the possibility of larger tyrannosaurid being mostly unfeathered was revived in 2017 [note] the discussion section of the paper does state it's possible they had feathering along the dorsum, especially since *Yutyrannus* came from a more basal side branch to later tyrannosaurs.
- In 2014 a year after the movie came out the Alaskan *Gorgosaurus* was reclassified as a new tyrannosaur species *Nanuqsaurus*. The latter also turned out to be a tyrannosaurine (robust tyrannosaurids) instead of an albertosaurine (gracile tyrannosaurids), more similar to *Daspletosaurus* or a smallish T. rex than *Gorgosaurus*.
- *Mere days* before the movie premiered, it was discovered that *Edmontosaurus* had a small fleshy crest on its head. Or at least one species, *E. regalis*, did (this is the species most likely depicted in the film, as the other *Edmontosaurus* species, *E. annectens*, is only known from fossil formations much younger than the other dinosaur species in the movie).

- A 2016 study suggested that the Alaskan *Edmontosaurus* may be its own genus, *Ugrunaaluk*; although a subsequent study in 2017 disputed this.
- A study in 2017 has established *Troodon* to be a dubious taxon due to being only known from a tooth, a similar case with such dubious taxa as *Trachodon* or *Monoclonius*. The same study also re-established *Stenonychosaurus* as a valid genus again, due to being known from better remains (which were formerly assigned to *Troodon*). The *Troodon* in the film would have been better termed as *Stenonychosaurus* instead.
- Later studies have indicated that the Alaskan dinosaurs (including *Pachyrhinosaurus* and *Edmontosaurus/Ugrunaaluk*) were probably present in the region year-round and did not migrate.